HEREDITY VERSUS EVOLUTION.*

AN INVESTIGATION.

WHEN Dr. Prosper Lucas published his work on "L'hérédité naturelle," in 1847, which was the first attempt to create the science of heredity, he established his theories on the metaphysical basis of two laws, one of spontaneity, by which nature tends freely to create and invent, and the other the law of heredity, by which nature tends subordinately to imitate and repeat her creations. He pursues this philosophical discussion through fifteen hundred pages, but his facts are so largely given on hearsay evidence that his book has little scientific value. He gravely cites the case of a Jew who could read the contents of a book through its covers without opening it, and says his son inherited this remarkable power. Yet Dr. Lucas's work no doubt gave the name to the study which has in the last few years become so important. Galton, in England, followed Lucas, but on a much higher level, in his "Hereditary Genius," 1865. Ribot, in France, made a considerable advance in his book on "Hérédité." Such works form a class by themselves. They constitute the necessary stage of theory and assumption through which the study has passed to its present more scientific period.

The word "heredity" had not been anglicised in Darwin's time, and consequently he discussed the subject, as did Galton,

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* This paper was read recently before the Anthropological Society of Yonkers, New York. For the purpose of exactness, the writer has made free use of his authorities, and the claim to originality, if any, rests on the grouping of the subject, the point of view from which it is considered, and the application of the principles advanced.

under the more correct word "inheritance." The transfer of the word to English is, it would appear, due to its use by Herbert Spencer, who either adopted it from some less known writer or took it direct from the French. In either case, he began its use without referring to the source to which he was indebted for it, or explaining critically its meaning.

Thus formally introduced as a scientific word, first, in the French by Lucas, and then in the English by Spencer, it gained an immediate and wide-spread acceptance, under the rule that it is legitimate to take a word out of its ordinary and familiar use and give it a special meaning in scientific discussions.

The definitions now given by various writers are in part as follows:

Weismann says: "The word heredity, in its common acceptation, means that property of an organism by which its peculiar nature is transmitted to its descendants." Again, "Heredity is the process which renders possible the persistence of organic beings throughout successive generations." Ribot defines its meaning as "that biological law by which all beings endowed with life tend to repeat themselves in their descendants. It is for the species, what personal identity is for the individual." Herbert Spencer, carefully following Ribot, defines it as "the law that each plant or animal produces others of a like kind with itself." Romanes says more accurately, "The great principle pervading organic nature, which is seen so mysteriously to bind the whole creation together, as in a nexus of organic affinity, is now understood as nothing more or less than the principle of heredity." Again, "We know that the characters of parents are transmitted to their progeny by means of heredity." He also speaks of "the large class of known facts and unknown causes which are conveniently summarised under the terms heredity and variability."

While these definitions show us its meaning, they also reveal how closely allied heredity is to evolution, and an examination of the definitions of the latter indicates that the two words are almost interchangeable. Evolution is defined by Romanes as the "theory of a continuous transmutation of species"; by another writer as "an

explanation how all existing species may have descended from one or a very few low forms of life," or how "existing forms of life have descended by true generation from preëxisting forms," or as Professor Huxley gives it, "the hypothesis which supposes the species living at any time to be the result of the gradual modification of preëxisting species." Evolution, in short, is a theory of descent. Heredity also has as its only topic "descent," and it inevitably leads us to a discussion of similar investigations, theories, and lines of thought. Though they treat of the same subjects, there are differences to be noted in the methods of treatment adopted.

Evolution may be said, in the words of Weismann, to be "a merely formal explanation of the origin of species, while heredity is an attempt to discover the real and genuine explanation." He adds that investigation "brings out clearly the speculative character of the whole hypothesis of evolution. Darwin only asked what was necessary to assume in order to explain this or that fact in heredity, without troubling himself to consider whether the assumption were borne out by facts or not." This is a fair deduction from the words of Darwin, where he writes, "the principle of natural selection may be looked upon as a mere hypothesis." Also, when he pointed out that his hypothesis of pangenesis was "merely provisional" and "an expression of immediate and by no means satisfactory knowledge of these phenomena." "Ideal theories," says Weismann, commenting on this frank acknowledgment, "are by no means useless. They are the first and often indispensable steps which we must take on our way to the understanding of complex phenomena."

Evolution is a theory, an hypothesis, an inspiration, and as with all the revelations which have come to mankind, the statement precedes the practical proof, which is taken up afterwards when the exhilaration, the divine afflatus, of the original conception has subsided. Then cold common sense takes the place of enthusiasm and the dissecting table, and the microscope the place of the pleasures of composition.

The comparison may be summed up in the antithesis that evolution is a theory of descent, and heredity the science of descent.

As we have found that the definitions and scope of evolution

and heredity are similar, so we may notice that the discussion of their fundamental propositions run parallel, and they both begin with the affirmation and denial of the same proposition. Evolution in its modern development is held to have taken its rise from the hypothesis of Lamarck, that the effects of use and disuse are inherited. Heredity may be said to have become a science when Weismann in his famous lecture denied that acquired characteristics are transmitted.

The transmission of the effects of use and disuse is the fundamental proposition of Lamarck. Existing forms of life, says Lamarck, have descended by true generation from pre-existing forms. Use and disuse produce development and atrophy of organs, and on this principle he based his theory of the transformation of species. Darwin also made prominent use of this theory, though he greatly amplified it by his hypothesis of natural selection. Spencer distinctly returned to it. He rested his whole system of biology, and in a conspicuous manner his "Data of Ethics," on the Lamarckian hypothesis of the transmission of the effects of use and disuse. His revival of this theory gave rise to the term Neo-Lamarckian. These hypotheses were only a development of the teachings of Lamarck and rested on his fundamental doctrine.

If the conclusion of Weismann be true, evolution is only the outgrowth of inherent and not added or acquired faculties, and the relation between one generation and another that of a trustee and not of a parent or creator.

If it can be proved that "the heredity tendencies" as claimed by Weismann "are transferred from generation to generation, at first unchanged and always uninfluenced in any corresponding manner by that which happens during the life of the individual which bears it, then all our ideas on the transformation of species require thorough modification, for the whole principle of evolution as proposed by Lamarck and accepted by Darwin, entirely collapses." Professor Osborne, of Princeton, has said, "if from the evident necessity of a working theory of heredity the *onus probandi* falls upon the Lamarckian—if it be demonstrated that the transmission of acquired characteristics does not take place, then we are driven to the

necessity of postulating some as yet unknown factor in evolution to explain the purposive or directive laws in variation." Weismann prefaces his "Lecture on Heredity" with the explanation that in it he "treats only of the transmission of acquired characteristics which has hitherto been assumed to occur," and adds that "the inheritance of acquired characters has never been proved either by means of direct observation or experiment." Pflüger also, in reference to the arguments in favor of Lamarck's theory, says, "Not one of these facts can be accepted as proof of the transmission of acquired characters."

These are broad statements, for Spencer had adduced these facts, in support of transmission: the diminished biting-muscles of lap dogs, diminution of jaws, crowded teeth, blind cave-crabs, the neck of the giraffe, the development of the æsthetic faculties, inherited epilepsy in guinea-pigs; and Darwin had rested his argument on a learned mass of scientific facts, such as the reduced wings of birds of Oceanic Islands, drooping ears and deteriorated instincts, wings and legs of ducks and fowls, pigeon wings, shortened breast bone in pigeons, shortened legs of rabbits, blind cave-animals, inherited habits, tameness of rabbits, short-sight in watchmakers and engravers, larger hands in laborers' infants, and inherited mutilations.

All these questions are discussed and ably treated by William Platt Ball, in his book "Are the Effects of Use and Disuse Inherited?"—in which he takes the negative. He finds in natural selection and panmixia a sufficient explanation of these phenomena. In reference to the giraffe, he quotes Darwin as saying, natural selection alone "would have sufficed for the production of this remarkable quadruped."

It was a great work for any man to undertake single-handed to reverse the received opinions of the scientific world on so fundamental a proposition as the transmission of acquired characteristics, and yet the opinion is now gaining general acceptance that this work Weismann accomplished, so that now the position he announced first in his "Essay on Heredity," which appeared June 21, 1883, has been received and accepted by the leaders of the evolutionary school. A. R. Wallace, who shares with Darwin the dis-

tinction of the first promulgation of evolution and natural selection, expresses his acceptance of Weismann's dogma of the non-inheritance of acquired characteristics in these words. "We cannot therefore accept any arguments against the agency of natural selection which are based upon the opposite and equally unproved theory that acquired characteristics are inherited, and as this applies to the whole school of Neo-Lamarckians, their speculations cease to have any weight." Prof. Ray Lankester writes, "It has never yet been shown experimentally that anything acquired by one generation is transmitted to the next."

Mutilations have been inflicted upon men and animals for centuries, such as flattening the head, boring the ear, tattooing the flesh, mutilations for ornament and as religious ceremonies, and yet not the slightest effect is thereby produced upon new generations of men and animals. The feet of Chinese women are normal, the bandaging for generations has not produced the slightest diminution in their size. Experiments have been made upon mice extending over a thousand specimens by cutting off their tails, without changing the form of that member in succeeding individuals. No child was ever born who knew how to read or talk or play on the piano. The instances which are narrated of the transmission of acquired characteristics are found upon examination to be idle tales, chiefly provocative of mirth, as when Weismann remarked on being told of the transmission of the marks of a broken leg, that it was strange the scar did not arrange itself in the form of an inscription "to the memory of the fractured leg of my dear mother."

To understand the scope of the dogma of Weismann we must distinguish clearly what is meant by an "acquired characteristic." Some diseases are transmitted, for instance, tuberculosis and smallpox; but a microbe which is supposed to be the foundation of these and other hereditary diseases, is not an acquired character. It is simply a parasite. Weismann defines an acquired characteristic as "a local and sometimes a general variation which arises under the stimulus of external influences." He gives the name of "somatogenic" to the characters which take their rise in the "soma" or

body, and "blastogenic" to characters which belong to the germ or type.

The doctrine is that no changes of the characteristics relating to the body and no mental acquirements which are not inherent in the type of the parent can be transmitted. As Burns sang—"A man 's a man for a' that," and the disadvantages as well as the advantages of surroundings, the polish, refinements, and acquirements of wealth and education, as well as the rudeness and ignorance of poverty are not transmitted. This doctrine only can explain the facts of life. From the common people and from the aristocracy alike, spring leaders of thought and men of action. There is no warning or intimation given of the advent of genius, and where we look for it, it is not found. The question then arises, what is the cause of the preservation of the type unchanged not only from generation to generation, but from one geological period to another? Why do offspring resemble their parents in not only general, but particular features? To account for these phenomena, the various theories have arisen regarding the germ as the sole bearer of life.

Weisner remarks that theories of heredity have always adopted units invented for that purpose, so that the composition of living matter out of very small units has become one of the fundamental points of such a theory.

That the world and all that it contains is composed of minute particles is a theory as old as Democritus who first propounded the atomic theory four hundred years before Christ. The discussion which began in his time against his theory and in favor of that of Anaxagoras who believed in the continuity of bodies and that all matter which had extension was likewise susceptible of division, has continued even down to modern times. Descartes denied the atomic theory. Leibnitz, on the other hand, regarded his monad as the ultimate element of everything.

When the microscope became developed into a serviceable instrument, in the middle of the seventeenth century, the Dutch philosopher Leeuwenhoek first discovered the corpuscles in the blood. But the imperfections of microscopes caused their use to be almost entirely neglected, until in 1832, when owing to the great improve-

ments in their construction, minute structural anatomy has been if not created anew, at least thoroughly revised. John Goodsir laid great stress on the office of the nucleus in the growth and reproduction of cells. Virchow still further developed the idea of the cellular structure of the animal organism. Hugo Van Mohl, and after him, Max Schultze designated the contents of the cells of vegetable and animal organism as protoplasm.

Ernst Brucke (1861) was the first to maintain the existence of small vital particles. He did not give them a name, but he opposed the old theory of cells and showed that their bodies must possess organisations quite distinct from the molecular structures of organic compounds.

Herbert Spencer considered that the whole organism is composed of what he called "physiological units," in all of which he says there dwells the intrinsic aptitude to aggregate into the form of that species.

Darwin followed with the theory that each cell of a living body possesses the power of giving off invisible gemmules or atoms, and these "gemmules are conveyed into the blood and thus circulate through the body."

Galton then wrote denying the circulation of the gemmules and substantiating his denial by satisfactory proof.

Elsberg introduces (1874) the term "plastidule" to designate the hypothetical ultimate particles of which protoplasm is composed.

Weismann began in 1883 to introduce his idea of germ-plasm, maintaining that the body which nourishes the germ-cells is only an outgrowth of one of them.

Nageli in 1884 attempted a mechanico-physiological explanation of the theory of descent. He calls his ultimate particle a "micella," which he defines as a minute crystal, microscopically invisible. In 1889 a writer named De Vries developed a theory of heredity in a paper on "Intracellular pangenesis," in which he substituted for Darwin's gemmules the ultimate vital particles which he called "pangenes" which are the bearers of the constituent qualities of the species.

But it is left to Weismann to develop a theory of germ-plasm

and continuity of life which carries the minuteness of organisms to a point beyond which it would seem impossible to go. Weismann is a microscopist, and he shows his reliance upon the microscope in the study of questions of heredity when he says, "I have not been able to make out by my own observations the correctness of these views as to the ancestral units, my impaired eyesight, which has so often put a stop to microscopical investigations, has again rendered the continuation of these researches impossible."

The most important of Weismann's doctrines, the non-transmission of acquired faculties, we have already alluded to; we now approach a second, the continuity of life. His researches in connection with these two discoveries elevate him to the highest rank among biologists, and a word may not be out of place regarding his style. He is a most satisfactory writer, for he never hesitates to express his belief as it is at the time of writing. The scientific caution of Darwin is entirely lacking in him. His constant and emphatic use of the words, "I believe," is a rebuke to the wishy-washy indifferentism which agnosticism has made popular, and sets a fine example of sincerity and independence to all who discuss scientific subjects. He is not writing for effect or to establish a theory, but to discover the truth. He has no weak pride of self-consistency, and chronicles his change of belief with unaffected simplicity and freedom. He abounds in trenchant epigrammatic statements, which carry conviction of their sincerity, if not always as to their truth.

In a word, his theory of germ-plasm is three-fold. By a long process of reasoning and investigation, he arrives at the conclusion that there is, first, a comprehensive physiological unit, which represents the ideal of the individual, whether a plant or animal. This he calls the "id," the first syllable of ideoplasm. It is the architectural thought of the individual. There is, second, the determinant, a unit which controls the method and direction of the development of the individual, which might be called the will if metaphysics had not gone out of fashion. Each "id" in the germ-plasm is built up of thousands or hundreds of thousands of determinants. Lastly, there is the biophor, the life-bearer, the smallest and most multitudinous of all the units. The number of possible kinds of biophors

is unlimited. These three units, somewhat similar in characteristics to body, soul, and spirit, constitute the historic, architectural, ancestral germ-plasm, or model from which the individual is formed. By means of a microscope the eye can see one of four thousand lines in four-tenths of an inch; but in size these biophors are inconceivably beyond the power of the microscope. In a human blood corpuscle squared there might be 703,000,000 biophors. Professor Mivart says, "I confess I do not believe such a collocation is possible." But these multitudinous aggregations allow the supposition towards which Darwin, Spencer, Weismann, and others have inclined that there are just as many independent and variable parts in the germ-plasm as exist in the fully formed organism. Under the power of the determinant, a single biophor might be developed into the skin of half the face, for instance, and as there are thousands of millions of biophors in each individual, the combinations of developed characteristics become infinite, and it is practically impossible for any two individuals to be alike. The circumstances, forces, conditions, accidents, as we call them, of life, or, as some say, the environment, compel development or restrain it, and produce an endless variety. But this variety is one limited by historic and inherent blastogenic characters. The multitude of biophors seems required not only by the individual, but by his descent. The characteristics of the immediate parents, as developed in the offspring, are inconceivably numerous; but if, as we believe, there has been an upward development from lower to higher orders, the characteristics possessed by a long ancestry of all these forms of life must be represented. An explanation of reversion and atavism is thus offered. Sickness, health, accidents, favorable or unfavorable surroundings will control the development of the biophors, and thousands of millions will never be called into activity, while those which are developed will determine the character of the personality which will result.

Thus the biophors representative of near or remote ancestors may be developed in any individual. Camoens, the epic poet of Portugal of the sixteenth century, not only fascinated his countrymen with the charm of his poetry, but also by his dazzling beauty

as a pure blonde, descended from and surrounded by a swarthy race. A single biophor might have floated down to him from some unrecorded ancestor, or even more remotely still from some yellow-haired animal, and, by an occult cause, have been so developed in him as to control his whole personality.

Shakespeare expresses and exhausts the thought when he puts into the mouth of a slave of Cressid this description of Ajax:

"This man, lady, hath robbed many beasts of their particular additions;* he is as valiant as the lion, churlish as the bear, slow as the elephant; a man into whom nature hath so crowded humors that his valor is crushed into folly, his folly sauced with discretion. There is no man hath a virtue that he hath not a glimpse of, nor any man an attaint, but he carries some stain of it."

This is the whole science of heredity anticipated by two hundred and fifty years.

But this variety is limited by historic and inherent blastogenic characters, and consequently development takes place within a prescribed range. Outside of this range is infertility. Each species is therefore sharply circumscribed on all sides by the doctrine of non-transmission and the continuity of life. Yet the evolutionist assumes to account not only for one species, but for all, and for all the changes by which the unicellular organism is differentiated into the multicellular.

Evolutionists of the extreme Neo-Lamarckian school, of whom Herbert Spencer is an example, if not the leader, account even for the existence of well developed moral sentiment and the feeling of obligation, the oughtness, by the Lamarckian principle. In his letter to John Stuart Mill, Spencer writes: "Moral intuitions are the results of the accumulated experiences of utility." He speaks in his "Data of Ethics" of "the inheritance of the effects of the pleasurable and painful experience in progenitors," which is the basis on which his whole psychological view rests. If there is no transmission, then, as Wallace said, "his speculations on the subject cease to have any weight," and the source of the feeling of oughtness can-

* Shakespeare here and elsewhere uses the word "additions" in the sense of characteristics.

not be utilitarian, empirical, and evolutionary, but must be inherent, intuitional, and blastogenic. The existence of native moral sentiments is confirmed by the earliest known writers, by the tenderness of Buddha towards human suffering, by the provision of the Jewish law, "thou shalt not seethe the kid in its mother's milk," by the writings of Catullus in Rome's most cruel era, and in modern times by the aptitude of savages to become civilised.

Let us ask, what effect has the theory of the continuity of the germ-plasm on the other theories we have been considering. Evidently it corroborates and confirms the non-transmission of acquired characteristics, for it proves that the germ is ancestral and historic, and it builds up an individual well furnished with capacity for development, as we used to say, or with biophors, which may be called into activity or lie dormant as the determinants may elect or circumstances require. Incidentally it excludes stirpiculture, and it shows the necessity of the education and amelioration of every successive generation and of every member of each generation, as the only means of race improvement. It shows that the parent is a trustee and not a creator, in which it follows the teaching of the highest scientific authorities. And finally, it shows that if evolution is to stand, some new principle must be adduced in its support, as was said by Professor Osborne; for the trend of non-transmission and continuity only teaches that all things must have continued from the beginning of their creation as they are.

There are two rival hypotheses to account for the differentiation we see in the organic world. Evolution, in the various forms in which it is held, and special creation in its varying shades of acceptance. The evolution of Lamarck and Spencer need not be referred to as that has already been sufficiently considered.

Evolution by natural selection is the solution advanced by Darwin and his school to account for variation, the origin of species, and the upward progress visible in the organic world: while the vast conservative majority, which learns slowly and moves cautiously, replies, on the authority of the consentient opinion of mankind, it is rather development by special creation.

Let us, then, get an understanding of these two theories from

definitions given by those who are authorised to speak. Weismann says: "Charles Darwin and Alfred Russell Wallace have taught us to understand by natural selection that process of elimination effected by nature itself, without the aid of man." Darwin himself says: "The term natural selection is in some respects a bad one, as it seems to imply conscious choice." Again: "For brevity, I sometimes speak of natural selection as an intelligent power. I have also often personified this power, for I have found it difficult to avoid this ambiguity." Again: "The principle of natural selection may be looked upon as a mere hypothesis." These definitions were enunciated when natural selection was first advanced to complete the theory of evolution. Professor Romanes, of Oxford, claims to have been a student of evolution for thirty years, and we may therefore learn from him the views held by the generation of Darwin's adherents who have followed him. He says: "Nature, so to speak, selects the best individuals out of each generation to live. As men by selection slowly but continuously improve their stock, so nature, by a similar process of selection, slowly but continuously makes the various species of plants and animals better and better suited to the condition of their life." Weismann, on the other hand, says: "Such a view is not strictly correct, for retrogression and degenerate forms play an important part in evolution." "There is no reason," continues Professor Romanes, "why we should set any limits to which this process is able to go."

He then condenses the arguments in favor of natural selection into four "facts," as he calls them. It must appear from the reading of these so-called "facts" that to so designate them is a peculiar use of language. They are theories, not facts. The first "fact" is the necessity for selection, because any one form of life would dominate the world if all its descendants were allowed to live. Does this theory not rather prove the necessity for the limitation of increase by destruction, the use of animals as food, and infertility? For food purposes the best specimens are selected, and this process would tend to deterioration. The second "fact" is this: "Nature is therefore always picking out or selecting the individuals best fitted to live." This theoretical process is therefore done by nature,

and not by the individuals themselves. The third "fact" is: "Individuals so selected transmit their favorable qualities to their descendants." If transmission is accepted, which theory is contrary to the teaching of Weismann's school as far as it applies to qualities acquired during the life of the individual, it must be allowed that unfavorable as well as favorable qualities may be handed down. The fourth and last "fact" is plainly on its face a theory. Professor Romanes says: "Our common mother, Nature (personified by a capital *N*), is able to distinguish between all her children. When an individual variation gives to that individual a better chance in the struggle for life, Nature (again with a capital *N*) chooses that individual to survive, and so to perpetuate the improvement in his or her progeny." Weismann has given the name Panmixia to the freedom all organisms possess to survive and commingle their variations. Panmixia intervenes therefore as a disturbing element, to prevent any orderly carrying out of the upward progress of natural selection, and to restore all variations to the architectural ancestral type.

In the next sentence Professor Romanes writes: "Now, I say that all these several component parts of Darwinian doctrine are not matters of theory, but matters of fact." Let us see where these facts lead him to, for it is probably in a different direction from that in which he desires to go. He personifies nature as an active, intelligent agent, ruling over organic life with a definite purpose, acting as a man does in cultivating his herds. He describes the individuals as selected without the exercise of their own volition for a purpose, and that is to make the various species better. On page after page he contrasts what he calls "the two rival theories of evolution and special creation," and in fact this comparison may be said to be the subject-matter of his book. Yet, when he comes to discuss the subject of natural selection, he is obliged to take refuge in a form of expression, which is only to be explained by the acceptance of the rival theory of special creation, which he is endeavoring to overthrow. Who is our common mother Nature? Why did he not give us a scientific definition of her? Where is her abode? How does she exercise her discriminating powers over her children?

He evidently has faith in mother Nature, in her wisdom and power and justice and goodness and truth. She must be, from his description, infinite and eternal and unchangeable.

After this, we read with a smile the last pages of his book, where he claims that "evolution has rendered the mechanical interpretation of nature universal," and where he thinks "the religious mind has suddenly awakened to a new and terrible force in the words of its traditional enemy, 'Where is now thy God?'" Professor Romanes will have to rewrite his anthropomorphic pages on natural selection, if he wishes the ordinary reader not to take his closing words as a *non sequitur*.

We can add to these explanations of Darwin and Romanes other meanings which are attached to the word Nature:—thus to the fortuitist it means chance, to the materialist it means the chemical and physical properties of matter, to the agnostic it means simply the play of forces in the organic and inorganic world, and to the theist it means a personal Creator. It becomes, therefore, a very convenient word, a symbol to which each one may attach his own particular meaning, and use it without compromising his views. It enables us to avoid Professor Lankester's sneer at American evolutionists, in that they have conspicuously abandoned the scientific method.

Having considered the views of Darwin and Romanes on natural selection, it remains to consider those of Weismann.

Professor Weismann does not disguise the difficulty he meets in attempting to incorporate the doctrine of natural selection into his theory of heredity. He walked upon firm ground when he was laying the foundation of his theory of the non-transmission of acquired characteristics. He has proved that doctrine beyond his power to recall it. But the task he has set before himself is to produce a complete system to account for the origin of species, and, like Darwin, he turns to natural selection, and says that the individual differences, caused by the various development of biophors, form the material out of which natural selection produces new species.

All his readers will assent to his remarks which follow this statement. He says :

"At first sight this conclusion appears to be very startling and almost incredible, because we are inclined to believe that the continued combination of existing difference cannot lead to their intensification, but rather to their diminution and gradual obliteration. Indeed, the opinion has already been expressed that deviations from the specific type are rapidly destroyed by the operation of reproduction."

This willingness to argue against his established convictions smacks of the pleader and not of the judge, and exposes Weismann to the criticism which he passed upon Darwin, and suggests the suspicion that he is only seeking what is necessary to assume in order to complete a system of heredity. Thus we see that Darwin, Romanes, and Weismann all progress bravely with their theories until they reach the crucial point of accounting for the origin of species. Then Darwin falters, and says natural selection is a bad term, that is, that it expresses on its surface the thought he wishes were true, but his scientific knowledge requires him to give it a meaning under which the thought breaks down. So Romanes, who is a faithful follower of Darwin, makes a break which is far more conspicuous. And then Weismann, returning to the same attack, and animated by the same purpose, actually surrenders the fruits of his greatest victory rather than acknowledge that there is conscious action in nature.

We see, from this difficulty which besets the path of these great thinkers, the true source of the strength of the theory of special creation. It accepts all that science has to say as to methods and chronology and development and evolution as a process, and when the point is reached where other theories break down, it offers the simple solution of the existence of a personal creator.

I must confess to much surprise when, to learn the most recent position of those who favor evolution, I took up Professor Romanes's book last summer and read his confession that there are but two rival hypotheses to account for the origin of species, evolution and special creation. For confession it must be called after all the arguments, scientific proofs, raillery and sarcasm, which have been ex-

pended in its overthrow. Spencer closes his chapter on the special creation hypothesis in these words:

"Thus, however regarded, the hypothesis of special creations turns out to be worthless—worthless by its derivation; worthless in its intrinsic incoherence, worthless as absolutely without evidence; worthless as not supplying an intellectual need; worthless as not satisfying a moral want. We must therefore consider it as counting for nothing in opposition to any other hypothesis respecting the origin of organic beings."

Remembering this attitude, which was originally taken by Spencer in 1852 and reaffirmed in 1864, and expecting rather to read in Romanes's book his belief that now all the thinking world was of one mind and that special creation was a forgotten myth, I say I was surprised instead of that to read that it was the one rival theory of evolution, and I said to myself, What, not dead yet, and after so many funeral orations? Surely this theory has a wonderful vitality.

A word must therefore be said of the present position of the doctrine of special creation.

It is the old belief contained in the words of Cicero—*Deus mundum aedificavit*,—God built the world. The fundamental idea of the special creationist is that of a conscious power working in and over nature. It is not against evolution or epigenesis, but against fortuity, chance, or spontaneous generation, or materialism, or the chemical theory. It is well described by Weismann in writing of Lamarckianism: "An ideal theory, an indispensable step which we must take on our way to the understanding of complex phenomena." It is a theory which personifies nature as Professor Romanes has done for us, and accepts natural selection in the sense Darwin and Wallace have taught us to receive it, as the selection by nature. It is held by educated men, not in the form satirised by Spencer, in that essay of his which Darwin so heartily applauded, but as a theory which answers more questions, solves more doubts, and raises more veils than any other which has ever been propounded by man. Though heavily weighted with the accumulated ignorance and superstition of all the ages, it is still the rival theory, because of such admissions as the following of Weismann: "I admit that spontaneous generation, in spite of all vain efforts to demonstrate it, remains

for me a logical necessity." And "I hardly think we shall ever reach the point of explaining vital processes by means of the well-known chemical and physical properties of matter, but until the explanation is proved to be impossible, it will in my opinion be unjustifiable for science to relinquish the attempt." Special creation therefore stands on the same footing as any scientific theory, as spontaneous generation, or materialism, an unprovable hypothesis, and yet to the vast majority of mankind a logical necessity.

We have now considered in rapid survey the theory of the non-transmission of acquired characteristics, of the germ-plasm and the continuity of life, of natural selection and the rival theories of evolution and special creation.

It remains to be asked what are the relations of these theories to each other, when brought together in the science of heredity, and it must be seen that if non-transmission and the continuity of life be accepted, then selection by nature and special creation coalesce under the definitions given them, and evolution becomes merely a description of the process and not of the power which accounts for the origin and variation of species.

A collateral result of the conclusions of heredity may be to shorten the world-chronology which it has been the fashion to lengthen indefinitely, and to modify but not supplant the fundamental biological and psychological beliefs of the ages.

THEODORE GILMAN.